IMPROVING INVENTORY OPERATIONS THROUGH DATA COLLECTION AND MONITORING

Case Etra

HÄMEEN AMMATTIKORKEAKOULU
HÄME UNIVERSITY OF APPLIED SCIENCES

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Iina Eiste

Iina Eiste

ABSTRACT

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Author	Iina Eiste	**Year** 2016
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ABSTRACT

This project was conducted for Etra Oy, which is a Finnish technology company that has specialized in providing industrial products and services. The subject for this thesis came from the commissioning company's need for product weight and volume information, which could be used in various business operations. The confining for the subject was received in December 2015, and the project was finished by May 2016.

The aim of this thesis project was to collect product weight and volume data that the company would be able to use in the future. Another objective was to create instructions for future data collection and monitoring, that the company could apply to their own operations. Database-, product data- and inventory management were used as theoretical background in this project. It was considered that these aspects gave a comprehensive theory ground to the subject in question. Information on the company's operations was gained from the employees of the company and the author's own working experience.

A questionnaire was used for collecting the data and the results were analyzed through Excel-based test formulas. The overall response percentage of the questionnaire was good and was sufficient for making valid conclusions. When analyzing the results it could be noticed that some aspects of the questionnaire required clarifications and some of the questions had worked well. Based on this research, it was decided that the questionnaire-based data collecting method could be recommended also for future use. On the grounds of these results, different options for questionnaire design were created for the company. In addition to the questionnaire, other data collecting methods were also proposed to the company. As for the data monitoring method, test formulas and a sample test were suggested to be used in the future. It is hoped that the company will continue to collect this weight and volume data, since it can be used to improve various operational processes inside the company.

Keywords database management, product data management, ERP systems

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TIIVISTELMÄ

Tämä opinnäytetyö toteutettiin Etra Oy:lle, joka on suomalainen teknisen kauan erikoisliike. Aihe tähän työhön tuli yrityksen tarpeesta saada tuotteille paino- ja tilavuustiedot toiminnanohjausjärjestelmään. Tuotteiden paino- ja tilavuustietoja voidaan käyttää moninaisten toimintaprosessien parantamiseen, joten oli tärkeää kehittää yritykselle tapa jolla kerätä nämä tiedot suurelle massalle nimikkeitä. Opinnäytetyön aihe saatiin rajattua joulukuussa 2015 ja työ viimeisteltiin toukokuussa 2016.

Työn tavoitteena oli kerätä yrityksen tuotteille paino- ja tilavuustietoja, joita he voisivat käyttää myös tulevaisuudessa. Tarkoituksena oli myös luoda ohjeet siihen, miten tuotetietoja voitaisiin kerätä ja valvoa tulevaisuudessa. Viitekehyksenä tässä työssä käytettiin teoriatietoa tietokannan hallinnasta, tuotetietojen hallinnasta ja varastonhallinnasta. Näiden aihealueiden uskottiin antavan vakaan teoriapohjan aiheeseen. Tietoa yrityksen toiminnoista saatiin muilta yrityksen työntekijöiltä ja oman työkokemuksen kautta.

Tietojen keräämiseen käytettiin kyselylomaketta, ja annettujen tietojen oikeellisuutta analysoitiin Exceliin tehtyjen tarkastuskaavojen avulla. Kaiken kaikkiaan vastausprosentti kyselyyn oli hyvä, ja voitiin sanoa että riittävä johtopäätöksien tekemiseen. Tulosten analysoinnin yhteydessä selvisi, että jotkin asiat kyselyssä toimivat hyvin kun taas jotkut vaativat täsmennystä. Tutkimustulosten perusteella päätettiin, että kyselyä voidaan suositella myös myöhempään käyttöön. Näihin tuloksiin perustuen kaksi erilaista kyselylomaketta luotiin myöhempää käyttöä varten. Näiden lisäksi myös muita vaihtoehtoja tietojen keräämiseen suositeltiin yritykselle. Tietojen tarkastukseen yritykselle ehdotettiin tarkastuskaavoja ja pistotarkastuksia varastossa. Tutkimustulosten pohjalta toivotaan, että yritys jatkaa näiden tietojen keräämistä myös tulevaisuudessa.

Avainsanat tietokannan hallinta, tuotetietojen hallinta, toiminnanohjausjärjestelmä

Sivut 37 s. + liitteet 8 s.

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1 INTRODUCTION

This thesis was conducted for Etra Oy and the objective was to collect and monitor the weight and volume data of one confined product group. The confined product group included the 1138 most warehoused products since March 2015. Since then there have been more than two pallets of each product in the warehouse simultaneously. The purpose of this project was to collect the missing weight and volume data for these products, and to examine how this data could be collected and monitored in the future when new products will arrive in the inventory. Based on the research also other possible utilization objects for the collected data were found. The framework related to the product data management (PDM), which is a discipline that manages data that is associated with the products. This can include product structures and configurations, product development and procedures that support the product lifecycle. Product data management relates closely to supply chain management (SCM), which controls and manages projects and the synchronization of the work throughout the product lifecycle. PDM and SCM tools and methods can be used for similar purposes, but often with different meanings. In this thesis project the product data management tools were used for improving various inventory operations. Different supply chain methods can also be used for these same purposes. In this project different PDM and SCM theories were used to improve different processes, which related to product lifecycle management and various inventory operations (Crnkovic, Askund & Persson 2002, 13-14, 59, 91).

1.1 Company introduction

Etola Group is a Finnish group of companies that sells, manufactures and imports industrial products. Industrial product sales began in 1956, and currently Etola Group’s product range includes a wide selection of products from several industrial fields. The traditional product range has included hydraulics, industrial rubbers and plastics, tapes, wire products and safety equipment. Nowadays the product range also includes bearings and power transmission equipment, grinding-, welding- and estate maintenance equipment, tools and electronic components. Etola Group also retails home products, boating equipment and delivers materials for the building industry. Etola Group’s goal is to provide a flexible entity of industrial products for their customers, and also to offer the most comprehensive collection of these products in Finland (Etola-yhtiöt 2016).

Etra Oy is part of Etola-companies, and it is a Finnish technology company that has specialized in providing industrial products and services (Etra Oy 2016a). It was incorporated in 2007, when Teollisuus Etola, TKA-Yhtymä, Pohjolan Tekniikka and other smaller companies merged into one (Etra Oy 2016b). Etra Oy’s mission is to add value to their customers by providing them products, manufacturing and service that allows their customers to focus on their own core business operations. Etra’s objective is to operate nationwide, but service their customers locally (Etra Oy 2016c).

Etra Logistic Center is located in Hämeenlinna, and it serves 37 locally situated Etra Megacenter stores. All the store replenishments and direct deliveries to the customers are done from there, as well as all the pickings related to other logistic services (Projektiuutiset 2011).

1.2 Research objectives

The objective in this research project was to collect weight and volume data for the chosen products and analyse the validity of the collected data. The chosen products were the 1138 most warehoused products in the inventory, and a majority of these products will most likely be stored in the warehousing automate in the future. The aim for this project was to create instructions on how to collect and monitor the weight and volume data in the future, when new products will arrive into the warehouse. This was done by collecting and analysing the data that Etra Logistic Center will be able to use to improve their business operations. When considering product data management, product models describe the product structures and attributes. The objective here was to collect different product attributes, which were product weight and volume data (Crnkovic, etc. 2002, 98).

The weight and volume information is relevant in many of the company’s operations, such as enhancing of the inventory capacity, transportation planning and increasing the efficiency in goods receiving. When the data is inserted into the company’s ERP-system, it is also available for everyone to use. The ERP-system can be defined as a tool, which companies use to integrate and coordinate data from different business areas (Monk & Wagner 2009, 1). The ultimate objective was to help the company to collect data efficiently in the future, and in this way to improve their various business operations.

1.3 Research method

This project was conducted as applied research, where weight and volume data were collected from the sampling products. The sampling products were the 1138 most warehoused products since March 2015, and the objects to this study were the suppliers of this sample group. The research method was a survey and the data was collected through a questionnaire (Hirsjärvi, Remes & Sajavaara 2007, 129-130)

The project was implemented as a quantitative research. When the data had been collected, certain predetermined factors were analysed through test formulas. The purpose of the test formula was to demonstrate if the given information corresponded with the test formula’s result. Based on these test formulas an error percentage was calculated. The most important information for Etra Oy was the unit weight, so this factor was analysed more profoundly. The rest of the collected data was left for future use of the company. The highest acceptable error percentage was chosen and the data considered as valid was inserted into the ERP-system (Hirsjärvi, Remes & Sajavaara 2007, 135-136).

1.4 Current state analysis

When considering the framework of this thesis, at the moment Etra Oy is actively collecting data from unit of measure, net weight and package size. This is done when new products are opened in the ERP-system, and the collection is done by the product ID opening templates. The data collection can be done for a large mass of new products simultaneously, or it can be done when a single product is opened into the system. Two different templates are used for these purposes.

If data is being collected for a large mass of products, a template for mass openings is being used. This is an Excel template, where to data for multiple products can be inserted at the same time. This file is sent to the supplier, and the supplier is asked to fill the data into the template. Data for mass product openings is being collected by the product managers. Some product managers create their own Excel files that they send to the suppliers, and then transfer the data from that file to the product ID opening template. Depending on the product manager, different procedures are being used. From the product ID opening template this data is inserted into the company's ERP-system. When data is collected for a single product, a single product ID opening template is being used. This can be found in Etra's intranet. It is sent to the product management department where the data is inserted into the ERP-system. The data from the supplier is collected by the purchasers, product managers or the person who wants to open this particular product into the system. Regarding the weight and volume information, here again only unit of measure, net weight and package size are requested from the supplier.

Currently Etra Oy is not regularly monitoring the validity of the products' weight and volume data. At the moment the validity of the data given by the suppliers is not inspected in any way, and it is trusted that the supplier gives the correct information. Etra does not send the suppliers any queries either, where they would be required to verify the validity of the given information. It is trusted that the supplier informs Etra if the product information changes, no other data validity monitoring methods are used in the company.

At the moment there are 286 787 active product IDs in the ERP-system of Etra, and there are approximately 30 000 product IDs that have balance in the warehouse. 163 498 of these active product IDs have unit weight defined, and 19 355 of them have unit volume in the ERP- system. It is not known who has added these into the ERP system and when, so the information cannot undoubtedly be considered as valid. Sometimes during the updating of the pricelists the supplier may report additional information, and depending on the product manager these might be inserted into the ERP system. The company's ERP-system has existing places for unit of measure, package size, net weight, volume and pallet height. Sometimes pcs per pallet is marked under the product's technical name. Additional product information can also be added to the text-interleaf of the product ID in the ERP-system.

2 DATABASE MANAGEMENT

In this chapter it is examined what databases really are and how they are managed. Databases should be mastered in a way that the data is coherent and updated in real time. For a company to function, it is important that the data is up to date and available for everyone who needs it. Databases in general can be defined as collections of related data and “database management system to be the software that manages and controls access to the database” (Connolly & Begg 2005, 4). In more exact words, a database is a source of information that many people or departments can use simultaneously. A database is a shared resource inside the company, where the data is integrated and there should be a minimum amount of duplication. The database preserves the company’s operational data, but also a description of it. This description is also called metadata, which means the data about data (Connolly & Begg 2005, 15).

2.1 Variety of databases

It is important to know that there can be many kinds of different databases that store information differently. Databases can be classified by the data type, data usage, location of the data and data users. Intended use of the database often defines what kind of database is chosen (Coronel & Morris 2015, 9).

When only one person is using the database, it is called a single user database. If there are multiple users, the database is classified as multiuser database. More people are able to use also the single user database, but only on at a time. If one person is using the database, others have to wait their turn. When considering the multiuser database, multiple users can use the database simultaneously. The multiuser database can also support only relatively small amount of users, for example a specific department in the organization. In these cases the database is called a workgroup database. If the database supports the whole organization, it is called an enterprise database. Enterprise databases are discussed more profoundly in following paragraphs. There can also be databases that support data only from one site, and those are called centralized databases. If the database sustains data from multiple sources, it is called a distributed database. Distributed database is more complex than centralized database, and “distributed database management system governs the storage and processing of logically related data over interconnected computer systems in which both data and processing are distributed among several sites” (Coronel & Morris 2015, 523). It was created when fast and unstructured access to databases was needed, and the centralized databases did not serve the purpose well enough (Coronel & Morris 2015, 9,253).

In some cases the databases can be classified based on the data that is stored in them. If the database contains a wide variety of data from multiple areas, the database is called a general-purpose database. On the contrary, discipline-specific database contains data from specific subject areas. Discipline-specific databases work well in areas where the information is focused mainly on one thing, for example medical history data can be stored in this kind of database. Nowadays the most popular data classification system however is based on the use of the data. Operational databases are designed to support the company’s day-to-day operations, where different transactions must be recorded immediately. Analytical databases focus on storing historical data and business metrics that are used in decision making inside the company. This kind of database stores information that can help for example with forecasting and future pricing. Operational database is essential in performing different processes inside the company, where the transactions need to be recorded as they happen (Coronel & Morris 2015, 9-10).

There are also many other kinds of classification ways for databases, and only few of them were introduced here. The intended use of the database affects greatly on what kind of alternative is suitable for the organization. When choosing a database, the amount of users should also be taken into account. The possible simultaneous use of the data also affects on what the database should be like. It can be said that there is no kind of database that suits all organizations, but the organization can choose what features they require for the database to work perfectly for them.

2.2 Database design

As it was previously said, the intended use of the database mainly determines what kind of database is chosen. Firstly it is important to identify the plans and goals of the organization, and then to define what kind of a database is required to carry out those objectives. It is also good to evaluate the strengths and weaknesses of the current systems, so the new database can be developed into the right direction. According to Connolly and Begg, the first phase in database planning is defining the targets and aims for the database. Once this is done, the objectives for the database should be determined. These objectives outline what features the database should include. When designing a database it should be decided how the data is collected, what format is used and how the implementation should proceed. Often the need for changing the current database or creating a new one arises from some defect in the company’s data management. The phases of database designing are examined closer in the next paragraph (Connolly & Begg 2005, 286).

The database lifecycle is simple. A database is created, maintained, improved and revised and ultimately replaced. Creating a new database begins from the planning of it. First it is examined if the existing system should be continued. If there are no problems with the current one and it serves all the company’s needs, there is no reason to change the system or modify it in any way. If there are some defaults in the system, it can be considered if the system should be just modified. Small modifications can improve the database efficiency significantly. If it is decided that the modifications are not enough, it should be pondered if the whole system should be replaced. All these options should be researched carefully. Ultimately the needs of the organization determine what kind of solution is being chosen. Analysis phase is the next step in database design process and here it is examined what features the database requires. Process flows and possible problem areas should be identified during this analysis phase. From the analysis phase the database design process proceeds to the detailed system design phase, where the final version of the database and its processes are designed. The final version includes all the necessary features that might help the system to work more efficiently. If this version is approved, the commissioning of the new database is implemented into the organization's operations (Coronel & Morris 2015, 412-417).

2.3 Database maintenance

The database must be revised continuously, so the data in the system is valid and up-to-date. According to Coronel & Morris 2015, maintenance operations can be divided into three different categories. Corrective maintenance corrects the errors and the invalid data in the system. Adaptive maintenance modifies the system as the business environment changes. Perfective maintenance improves the system operations, as better procedures are invented. To sustain functional database, all these maintenance operations are required. So the database could be up-to-date, it needs to be revised and maintained continuously (Coronel & Morris 2015, 417).

The performance of the system should be monitored, so the performance does not fall under an acceptable level. Database management system usually offers many tools for the performance monitoring. The performance levels can be supervised for example through database usage and query execution strategies. The performance levels give information about what processes work well and what needs to be improved. Monitoring is essential in enhancing the database operability and modifying the system into more user friendly direction (Connolly & Begg 2005, 306).

2.4 Enterprise resource planning systems

Enterprise resource planning, also known as ERP, stands for programs that companies use to coordinate information in different areas of business. A company's business operations usually are centered in the ERP-system. The ERP-system is often a common database throughout the company, where all the business processes are collected in one place. Business processes can be defined as a collection of activities that create input or output. ERP-systems are designed to integrate different business processes throughout the company, and in this way make sure that the company can operate as efficiently as possible (Monk & Wagner 2009, 1).

2.4.1 Development of ERP-systems

ERP-systems were developed for the need of an integrated database inside the company. A system which would support operations from all business operations was required, and ERP-systems were created to integrate the data from different databases into a one system. This system would serve all the departments in the company, and make sure that the data was in a coherent format. ERP-systems decreased the duplication of data, and made sure that the same information was not presented differently in two places.

These systems facilitated the data management inside the company, and made the business processes easier to control (Monk & Wagner 2009, 18).

As it was stated earlier, ERP-systems were created to support all the company's resources in one place. Nowadays ERP-systems are also considered as a method of organizing data. Data in the ERP-system is organized in a way that an employee can perform his or her duties as efficiently as possible. With ERP-systems it is also possible to integrate business processes. Since all business processes affect some other process, it is important to know what the consequences from each action are. When these consequences are surveyed, it can also be known what features the ERP-system requires (Van der Hoeven 2009, 16-17).

ERP-systems usually manage master data of the company. Master data means the data that is available and used by several applications throughout the system. Features in the ERP-system are typically formed based on different parts of the master data. Master data usually falls into four different categories; people, things, places and concepts. Referring to the framework of this thesis, the things-category consists of products, parts and assets. Master data includes the most essential information to the company, and based on the master data the ERP-system can also be created. For the company it is natural to locate the master data into the ERP-system. The company's business operations are managed through the ERP-system, and this data is a necessary part of the business processes. With ERP-systems the data management is easy for the companies, since the data is available for all the users and it is collected in one place (Wolter & Haselden 2006).

2.4.2 Enterprise information management

Enterprise information management (EIM) relates closely to the topic of this thesis, and in this chapter it is examined what this actually means. As a concept EIM is relatively new, and the first book on it was published in 2010. It is defined as s system "for structuring, describing and governing information assets across organizational and technological boundaries to improve efficiency, promote transparency, support agility and enable business insight" (Baan 2013, 80).

The currently used model is the EIM triangle, where the center of the triangle includes the information and the sides consist of technology, people and process. In the triangle model information has four important aspects; accessibility, availability, relevancy, and interpretability. Information requires all these aspects to be met. Accessibility means that the employees know this information is in the system, and availability makes sure that it is available for everyone to use. Relevance is about the facts being relevant and the interpretability means that these facts can be interpreted. From a technical point of view, the data is included into the processes using a certain system. People include this data into the processes, which follows a fixed order of operations. Briefly described this forms an enterprise information management system, where information is integrated and available for the whole organization (Baan 2013, 81-82).

2.5 Product data management

Product data management, also known as PDM, is a system that is used for different kind of data management. PDM can be defined as a "discipline of controlling the evolution of a product and providing other procedures and tools with the accurate product information at the right time in the right format during the entire PLC" (Crnkovic, etc. 2002, 19).

Product data management information is used and created when performing other business processes, such as sales, purchasing and marketing. Product data management comprises functions from different systems, but product data management system is used for implementation of the product data management. PDM systems usually are divided into two different categories, which are user functions and utility functions. User functions provide operability for the user accessing the PDM system, and these are divided into five categories. Those categories are workflow and process management, product structure management, classification management, program management and data vault and document management. Utility functions provide point of contact for different operating environments. These can also be divided into five different categories, which are application integration, administration, data transport and translation, image services and communications and notification. Due to the framework of this thesis, data vault and document management and workflow and process management are explained separately (Crnkovic, etc. 2002, 20-21).

Workflow management in PDM systems means that the correct information is available for the right users at the right time. Workflows include different process steps, and with PDM workflow management the defined processes can be managed automatically. This way specific business processes can be carried out. This relates to the subject of this thesis in a way that also weight and volume data are automatically part of some specific business processes. These can be for example the total weight of a purchase order that is being calculated automatically. This product data is stored in data vaults. Product data can also be called as metadata, since it describes different properties and information about the product data. Regarding the subject of this thesis, product data includes weight and volume information. Data vault and document management is used for storing and maintaining this kind of data, which strongly relates to the company's business operations (Crnkovic, etc. 2002, 22-23).

3 INVENTORY MANAGEMENT

3.1 Definition of inventory

All organizations keep some kind of inventory and it is often necessary for the operability of a company. The definition of an inventory can be considered as the intangible and tangible material that a company keeps in order to support their business operations. This material can include raw materials, unfinished goods, supplies used in manufacturing and finished goods (Muller 2011, 1). In other words, inventories are places where goods are stored for future use. This can be future sales, assembly and production, transportation to other location or other usage inside the company (Bhatnagar 2009, 33).

3.2 Inventory layout

When establishing an inventory, certain aspects need to be taken into consideration for the inventory to be able to operate efficiently. The main goal is that the inventory can use its full capacity and the amount of waste space is reduced to the minimum. It is good to recognise the following factors when planning the layout of an inventory:

Space where the items are storaged: The locations and the methods how the items are placed in the inventory

Receiving and shipping areas: Locations where the incoming and outgoing deliveries are received and shipped

Picking-, packing- and assembly areas: Locations for the picking, packing and assembly is being done

Equipment: What kind of equipment is being used inside the inventory

(Viale 1996, 80)

When designing the inventory layout, individual items need to be located in the warehouse. The features and the liquidity of an item define the inventory location where the item should be placed. There are two basic ways for determining the warehouse locations for the products. In Fixed Location Systems the products are assigned to permanent locations. These locations do not vary, which makes it easier to remember them. This makes the item putaway and retrieving process faster, which increases the efficiency in the inventory. This system decreases the information processing, but on the downside it suits only for inventories which have lot of space (Viale 1996, 81).

Another locator system is Floating Location System, where the products do not have any fixed locations in the warehouse. Products are situated to places that are free at the moment, and they can be stored in several locations simultaneously. This system requires good database management and lot of data processing. It still is good in smaller inventories, where all the warehouse capacity must be used efficiently (Viale 1996, 81).

Zoning system is one of the layout models that can be used for locating items in the warehouse. The inventory is divided into areas based on the item's characteristics, and only certain kind of products can be placed in a certain area. This area division can be based for example on the dimensions of the products, their weight or their liquidity. The product locations can be moved around the area, so the system is flexible inside this certain area. This system allows efficient space utilization, but it still has some kind of organized structure (Muller 2011, 61-63).

When selecting the right locator system for the company, several aspects need to be considered. If product locating is examined based on its physical features, the biggest concerns are the following:

- Available space
- Product dimensions
- Shape of the products
- Weight of the items
- What is the storage system in the warehouse
- Are the items stackable

Since there is always limited amount of space, locating must be done in a way that the space is used efficiently. Waste space should be left at the minimum. The products should be located into storage locations, where their physical dimensions suit the storage cell the best way possible (Muller 2011, 51).

3.3 Inventory capacity

When planning the product locations in the warehouse, it should be thought of what kind products are being stored. The physical features of the products and different kind of warehousing systems affect in the product locating process. Some items need to be stored in certain locations because of their physical features, for example the product dimensions or weight. Some products may be stored in certain places due to their high liquidity. Nonetheless, considering product features they should be placed in a way that minimum space is being wasted. Product location depends also on the available storage cells or other locations. Here it is discussed how the inventory levels can affect on the efficient space utilization in the inventory (Muller 2011, 79).

3.3.1 Inventory levels

Inventory levels have a great impact on the efficient use of warehouse capacity. Correctly set inventory levels can have an effect on how efficiently the space is used inside the inventory. If a product with low liquidity has high inventory levels, this wastes space in the warehouse. Inventory levels can be determined by using either Independent Demand Models or Dependent Demand Models. Suitable model is selected depending on the company's overall business plan and objectives, and it should support the company's manufacturing and marketing strategies. Dependent demand consists of the components that are required to satisfy the independent demand (Viale 1996, 101). Independent demand models are used when the product demand is influenced by customer demand or other demand that the company cannot control. They define the inventory levels for finished goods and are mostly used by manufacturing companies, retailers and wholesalers. There are five different models for independent inventory models, and these are presented in the following paragraphs (Viale 1996, 15-16). Since the framework of this thesis relates more to the finished goods inventory, the dependent demand is not examined here more profoundly.

The first of these is Fixed Reorder Cycle Inventory Model. The main point in this model is that the orders are being purchased in predetermined, fixed time schedule. The order might be placed for example weekly, monthly or early. According to the forecasts and targeted inventory levels the order quantities may vary. The objective in this model is to purchase the amount products that take the existing inventory levels to the targeted inventory levels. Second independent demand model is Fixed Reorder Quantity Inventory Model. This model differs from the Fixed Reorder Cycle Inventory Model in a way that the quantities being purchased are fixed. Often the fixed quantities are determined by using Economical Order Quantity (EOQ) calculations. EOQ describes the amount being purchased, in a way that the ordering and inventory carrying costs are retained at the minimum level. Using the EOQ requires that the demand and costs stay approximately the same throughout the year (Bowersox, Closs & Helferich 1986, 193). In this model an order is placed when inventory levels reach predetermined reorder point. Reorder point should be set at a point where inventory levels are sufficient compared to the estimated demand during order lead-time. Figure 1 illustrates how reorder point with safety stock operates. Reorder point is set in a level where inventory levels do not reach zero, and the new order should be received before safety stock needs to be used. The order's lead-time is a big factor in determining the reorder point, and safety stock works as a buffer against stockouts if the lead-time is longer than expected. When using reorder point with safety stock the inventory levels are reviewed periodically, and all the orders can be placed at the same time. In smaller inventories this can be done for all the items in stock at once. (Viale 1996, 15-18)

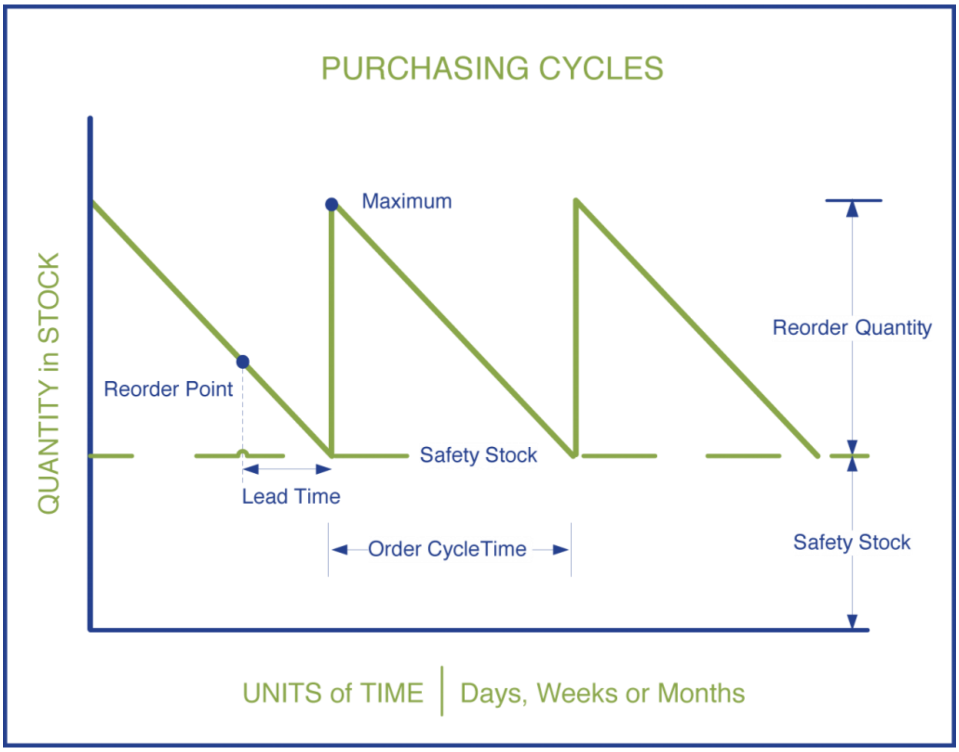


Figure 1 Purchase Assist Technology. FAQ. http://purchase-assist.com/faq/

Third model is the Optional Replenishment System, and here an order is placed only after the acceptable order quantity is reached. This model is used when it is not economical to order in small quantities. It is usually used for C-class items, where the value is not high. The order quantity is calculated by subtracting the on-hand inventory from the maximum inventory level, and if the result is higher than the predetermined minimum order quantity an order can be placed. This model's advantage is its simplicity, and it is suitable when the current stock needs to be used before replenishment. The contrary for this model is the Joint Replenishment System, where several items are combined in the same purchase order to obtain transportation or volume discounts. This model works when all the purchased items are kept in the same warehouse and ordered from one supplier. Joint replenishment system can decrease transportation and order costs, since only one order is placed. This way all the items are covered by one freight cost. If certain volume or monetary value is reached, this can result in discounts or freight-free delivery. Work in accounting is also decreased, when all the items and the freight are on the same invoice. This model works when the purchasing operations and item inventories are centred (Viale 1996, 19-20).

Forecasting is the fifth independent demand model, and it is used for estimating the future demand. By using forecasted demand, it is also possible to determine targeted inventory levels (Viale 1996, 29). It can be said that forecasting is a projection of customer demand. Forecasting is usually done by calculating and analysing the already existing data from the products. This data can be for example historical demand patterns, scheduled promotions and campaigns or customer intelligence. Forecasting is usually done for the purpose on predicting the future sales. When the estimated amount of sales is forecasted, it is easier to prepare for these with setting appropriate inventory levels. When forecasting the demand it usually is expected that the past demand patterns will be repeated (Bowersox, etc. 1986, 108-110).

One thing that can affect on the correctness of the forecasted demand is the forecast error. Forecast error can be defined as the difference between forecasted demand and the actual demand. When forecasting the demand, the impact of forecast error should also be taken into consideration (Bowersox, etc. 1986, 113). Defining the standard deviation of the forecast error can help with the inventory level designing. By using standard deviation of the forecast error calculation, it can be calculated which inventory level allows the forecast error and still establishes certain probability for on-time deliveries (Viale 1996, 31).

4 IMPLEMENTATION

In this thesis the collection of data was conducted as a questionnaire. The questionnaire was composed to an Excel file, which was sent to 129 suppliers. The suppliers were requested to fill the questionnaire and send it back to the commissioner. The results were combined into a joint Excel file that was given to the representative of the commissioning company.

4.1 Supplier segregation

In the beginning of the research, the ID of each Etra product had to be processed to find the right supplier to each one of the products. This was done by searching the right suppliers from the company's ERP system. The data required included the supplier's ID number and the supplier's name. The suppliers' product names, product IDs and Etra's product IDs also had to be searched from the ERP system. Based on this information it was possible to segregate the products under different suppliers. The suppliers and their products were divided into separate Excel files, and based on these files the questionnaires were formed.

4.2 Required data

The basis of the required information was decided together with a representative of Etra. The information required by Etra included package size, pallet size, pallet layer, unit weight, unit volume and package and pallet volumes, and the questionnaire was formed based on these factors. In addition to this data, issues such as: stock keeping unit, full pallet size and package weight were added to the questionnaire.

Stock keeping unit was required, so it would be possible to estimate if the data given by the supplier was correct. In some cases the supplier may have different conceptions on what certain unit of measure means, and this way the data given by the supplier could be compared to their stock keeping units.

Package size and pallet size were added to the questionnaire, since they were essential information for purchasing operations inside the company. This data often defines the quantities that are being purchased from the supplier. Many suppliers may have a minimum order quantity, which is sometimes one package. Information on package size is also often needed in sales. If the product is not kept in the warehouse but supplied only based on customer orders, in some cases the customer is also required to buy that package size. Pallet size was required for purchasing operations as well, since some suppliers might sell only full pallets. Even though some product IDs might be purchased only in full pallets, all of these product IDs do not have the quantity information in the ERP system. The exact quantity per pallet is important information to the company, since in some cases the full pallets might be transferred to storage cells without any deconstruction.

Pallet layer was considered to be relevant to the company when determining the suitable storage cells for goods that arrived in full pallets. Full pallet size was required for the same reason. With full pallet size information it would be possible to know in advance how high a storage cell is needed for certain products. This information helps the company to plan their inventory layout in advance, which enables them to get the full capacity out of their warehouse.

Unit weight was a required piece of information by the company, and in addition to this package weight was added to the questionnaire. These are both essential pieces of information in planning for smaller deliveries that are shipped in cartons. This information can also be used in planning of the warehouse layout. Heavy products are not usually placed on high picking slots, so the picker's working ergonomics could be taken into consideration. With the weight data the picking slots of heavy items can be designed better when planning the warehouse layout.

Currently most products do not have any volume data in the ERP-system. Since this is essential information for the company, it was decided to add it in the questionnaire. Volume data can be used in the warehouse layout designing, and it is relevant also in other company's operations. Part of the sampling products will most likely be stored in the warehousing automat in the future, so especially unit volume and package volume were important pieces of information. With this data it will be possible to calculate how much space each product requires in the warehousing automat. The data can also be used in the planning of the automat layout. Pallet volume can be used when designing suitable storage cells for full pallets, but also in the reception of goods. When pallet volumes are known in advance, it is easier to prepare and make room for incoming deliveries.

4.3 Questionnaire design and supplier contact

The questionnaire was composed into an Excel file that consisted of two different tables. The first table contained the questionnaire, which included supplier and product information, columns for requested data and an example on how to fill the questionnaire. Supplier and product information included basic information about the suppliers and the products; supplier code, supplier name, Etra product ID, product name and supplier's product ID. These were added to the file before the questionnaires were sent to the suppliers. The information required from the supplier included: stock keeping unit, pcs per pallet and package, pallet layer and full pallet size, unit and package weight and unit-, package- and pallet volumes. This questionnaire can be seen in Appendix 1. The second table was a Concept definitions-table, which included a definition for each requested data concept. This is presented in Appendix 2.

During the research project the suppliers were contacted individually via e-mail. A cover letter was sent with the questionnaire, which explained why Etra Oy was collecting this information. This letter can be seen in Appendix 3, and it explains what actions were required of the respondent after receiving the questionnaire. Questionnaires were sent on 12. February in 2016 and the respondents were given two weeks of responding time. After two weeks on 29. February a reminder message was sent to the suppliers, which is shown in Appendix 4. After this message no more reminders were sent to the suppliers.

4.4 Data collection and storing

The answers were collected into a joint Excel file as the suppliers sent their answers to the questionnaires. This was done in order to ease the inserting of data into the ERP system. The purpose of the questionnaire design was to be able to copy the suppliers' answers straight from the questionnaires to the joint Excel file. As the first questionnaire answers started coming, it became clear that this was not possible in all cases. Before the answers were transferred to the joint Excel file, each answering sheet was quickly audited to inspect if the answers were realistic and in the correct form. In some cases the supplier had answered in a different form than requested, and they needed to be contacted again. This way it was possible to clarify what the answer was in the correct form.

All the suppliers did not follow the instructions on how to fill in the questionnaire, which made it difficult to copy the answers straight from the questionnaire into a file. In some cases the answers were not situated in the questionnaire, and the supplier had to be contacted again. These suppliers were requested to fill in the questionnaire again by following the instructions, and then return it again as soon as possible. Some of the answers were correct from the first request, but the process of collecting and auditing the data required a lot of re-contacting the suppliers. As the answers were received and corrected into the right form, they were transferred to a joint Excel file.

The file that included all the collected data was handed over to the commissioning company's representative. This way the company was able to store the data for future use. During this process the data had not been inserted to the ERP-system, so at the time when this thesis was completed it was not known how the data was to be utilized.

5 ANALYSIS OF RESULTS

The sampling of this thesis included 129 different suppliers, from which 54 suppliers were domestic and 65 were foreign. In total there were foreign suppliers from 16 different countries in Europe and Asia. The total response rate from the domestic and foreign suppliers was good, 75.2 % out of all of the suppliers answered the questionnaire at least partly. 50.4 % of the suppliers answered after the first query and 24.8 % of the suppliers did not answer at all. The percentages can be seen in Figure 2.

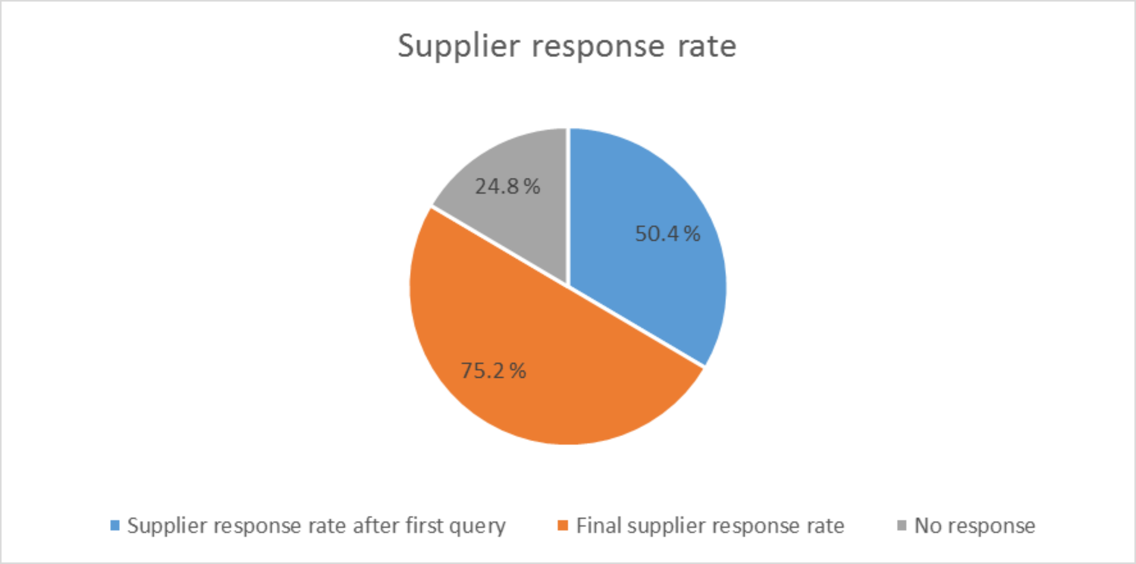


Figure 2 Supplier response rate

There was a slight difference in the response rates between the foreign and the domestic suppliers. As it can be seen in the Figure 3 the final response rate between domestic and foreign suppliers differed 18.23 %, where the domestic suppliers had a higher total response rate. The response rate after the first query differed only by 5.44 %, so it can be said that this was approximately the same with both the foreign and the domestic suppliers. About half of the suppliers in both supplier groups responded after the first query, which can be considered a good result. The difference in the response rates after the reminder might be explained with the fact that domestic suppliers were easier to reach and be in contact with, since they were physically closer. Especially for some of the domestic suppliers Etra is a large customer, so the suppliers reacted to the queries in a more serious manner. Considering the answers, there were more problems with the foreign suppliers in relation to the domestic ones. This might be caused by the different conceptions about certain factors, also some of the foreign suppliers did not want to fill in the answers to the questionnaire. When the differences between different countries are considered at a more general level, it can be said that Finns generally replied diligently and this may vary between different countires. This might be one of the reasons behind the domestic suppliers' higher response rate.

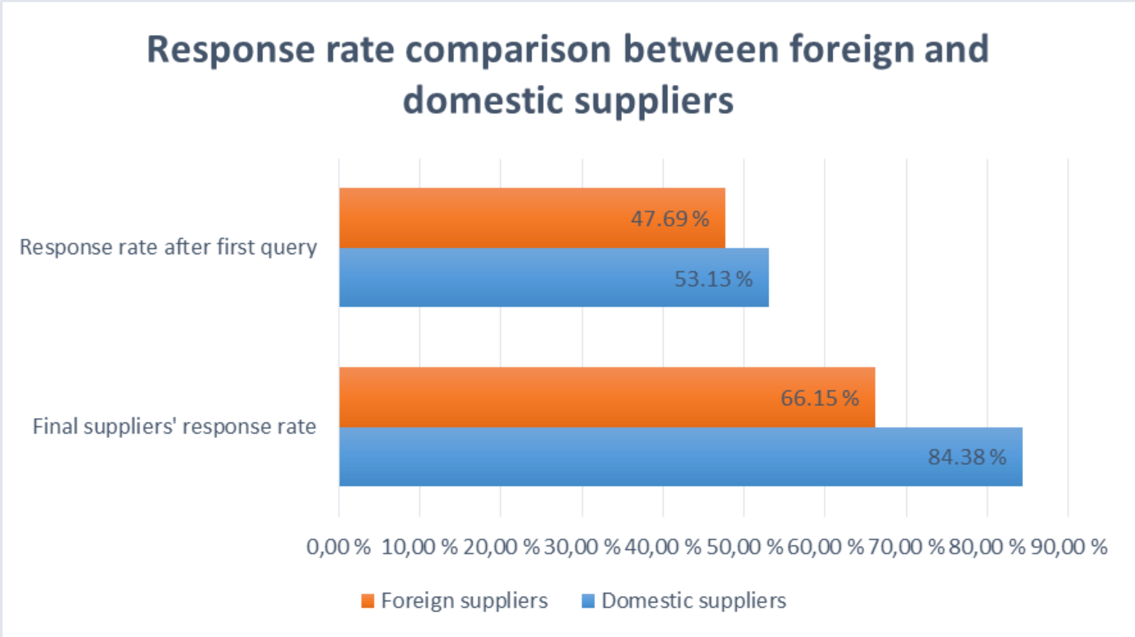


Figure 3 Response rate comparison between foreign and domestic suppliers

All together 1038 product IDs were included in the questionnaires, and 70.7 % of them got at least partly answered. All the product IDs did not get all the required information, but in Figure 4 can be seen the response rates for each of the requested factors.

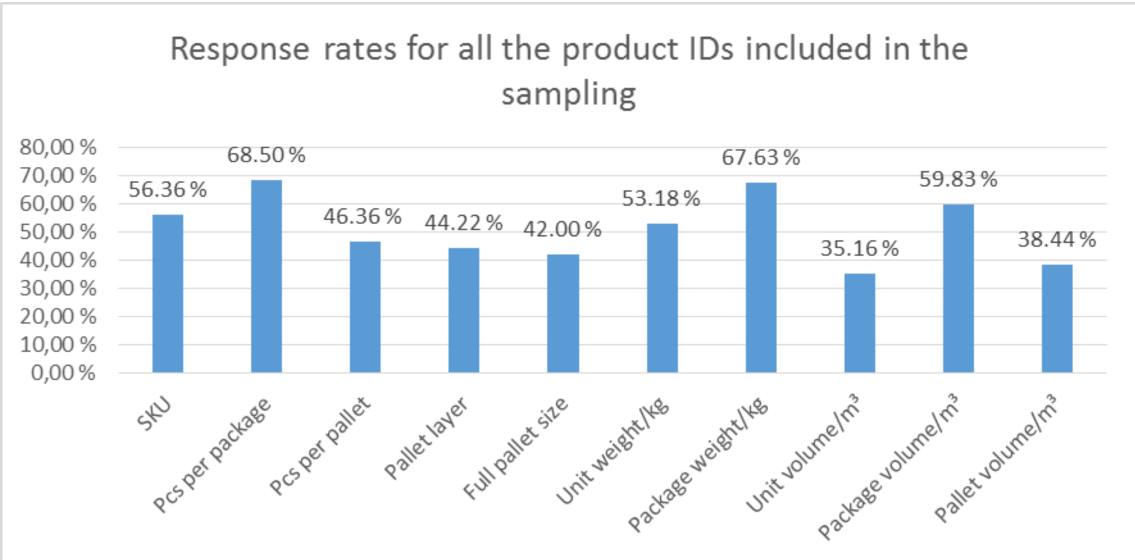


Figure 4 Response rates for all the product IDs included in the sampling

As it can be seen, the lowest response rate was in the unit volume. This can probably be explained with the fact that some of the products included in the sampling were not measurable in units. If the unit volume is compared to package volume, it can be noticed that the package volume had almost twice as high a response rate as the unit volume. This can probably be explained with the easier measurability of the product packages, since the figures are often clearer than with individual products.

The products are also often stored in packages, so the package volume information might be more important to sustain.

The second lowest response rate was in pallet volume. Some part of this can be explained with the fact that the suppliers do not store the items on pallets. All in all the lowest response rates were in volume data, and it can be considered what might have caused this kind of result. One possible reason was that the volume data is not that valuable for the suppliers. All the suppliers do not keep the products in their own inventories or the products might be make-to-order, when the volume information is not required for storing the products. Another possible reason for the low response rate might have been that the product volumes are too hard to measure, so the suppliers do not monitor them.

The highest response rate was in pcs per package, which usually is considered as basic product information. In that way the result was expected, since most of the suppliers store this kind of data. Second highest response rate was in package weight, which also can be considered as basic product information. When compared to the unit weight, package weight has approximately 15 % higher response rate. Unit weight’s lower response rate could have also be explained with the fact that unit information is less sustained than package information. With some products it is not worthwhile to collect unit weight information, for example if the product is remarkably small, light and stored and sold in packages. Good examples of these products are different kind of screws, which are sold in cases. For the supplier it might not be reasonable to collect unit information, if the products are anyway stored and sold in packages.

When examining the pallet information response rates, it can be seen that the response rates for pcs per pallet, pallet layer and full pallet size were approximately at the same level. This level is relatively small compared to the other response rates, and again partly it can be explained by the suppliers not storing the items on pallets. Some of the suppliers did inform that they do note store the products on pallets, and so on they do not have any pallet information. The highest response rate out of these three was in pcs per pallet, which usually is basic information if the products are stored in pallets. Pallet quantity is important when calculating and monitoring inventory levels, as well as delivering full pallets from the inventory. Pallet layer and full pallet size response rates had only 2.22 % difference, where full pallet size had slightly smaller response rate than pallet layer. Some companies use always the same pallet bases, and this might have been one reason for the slightly higher response rate in pallet layer. Pallet layer information can also be used for tracking purposes, which might make it a little more monitored than full pallet size. Full pallet size may be more challenging to give, if the supplier does not have any full pallets in the inventory at the moment.

Stock keeping unit had the fourth highest response rate, which still was not more than 56.36 %. There were also quite a lot of problems with the SKU answers. This response rate possibly can be explained with the fact that the concept of stock keeping unit might not be so widely known among the suppliers, and the purpose of it caused confusion. All in all the response rates were better than expected, and as a conclusion it can be said that the questionnaire worked relatively well.

5.1 Validity analysis

The validity of the data given by the supplier was tested through test formulas. Based on the test formula's result, an error percentage was calculated for each of the products that had some kind of result from the test formula. Since unit weight information was the most important data for the company, it was decided with Etra's representative that for this thesis the more profound examination would be concentrated on unit weight data. When analysing this data, those products that had an error percentage of over 20 % were examined separately. The 20 % limit was chosen to separate the products that had high error risk and those items were the error did not affect the result substantially. It was considered that in products that had an error percent under 20 %, the error was not substantial enough to impact on the product's unit weight validity significantly. Products that had an error percent was over 20 % were evaluated separately. It was examined why the error percentage was so high and what reasons might have caused this.

5.1.1 Test formulas

Test formulas were created for unit weight, package weight, unit volume and package volume. With the formulas it was possible to evaluate the validity of the data given by the supplier. Below are presented the test formulas that were used for package weight and volume evaluation. In these test formulas the package quantity was multiplied with the unit weight or volume. The result describes the estimated package weight or volume, but here the weight of the packing material or empty space inside the package is not taken into consideration.

- Package weight = Pcs per package x Unit weight
- Package volume = Pcs per package x Unit volume

As it was previously addressed, the packing material is not included in the package weight formula. If the packing material was included in the formula, the result would be slightly higher. When creating the package weight test formula it was decided that if the supplier given data was packing material's amount higher than the test formula's result, the value given by the supplier was considered as valid. The maximum difference between the two results still had to be realistic. The packing material's weight depends on the product, but in most cases the error should not be significant. If the company uses these formulas in the future, it is suggested that some kind of percentage limit is set to define the valid and invalid results.

The package volume's test formula was consisted much in the same way as the package weight test formula. The value given by the supplier cannot be straight compared to the test formula's package volume. The empty space inside the package is not taken into account in the calculations, so it can be assumed that the supplier given package volume should be higher than the test formula's result. Anyhow since the unit weight was the most crucial information to the company, the analysis of package weight and package volume was left at this state. The error percentages are calculated for later use, if the company decides to include this data into their ERP-system.

Unit weight and unit volume's test formulas were created to compare the already existing data in company's ERP-system to the values given by the supplier. Here again the error percentage between the two results was calculated. This was done by using the formula presented below:

- Unit weight error percentage = (Supplier given unit weight – ERP-system's unit weight) / ERP- system's unit weight

- Unit volume error percentage = (Supplier given unit volume – ERP- system's unit volume) / ERP-system's unit volume

As it was previously said, the closer result analysis was focused only on the unit weight. Unit volume analysis was also left at this state, but here again the error percentages were calculated in case the data would be used in the future.

5.1.2 Unit weight analysis

As it stated in the previous chapter, the unit weight was the most important information for the company and the analysis of this was taken further than the other pieces of information. All the products which had an error percentage of over 20 % were taken into closer examination. 20 % was chosen to be the highest error percent, which was accepted automatically. It was considered that with products where the error percent was less than 20 %, the error was so low that it did not significantly affect the unit weight. In total there were 552 answers in the unit weight-column, and 227 of these product IDs had an error percentage of over 20 %. If all the product IDs included into the sampling were taken into account, 21.87 % of the products had an error percentage of over 20 %. The percentages between "error percentage less than 20%", "error percentage over 20 %" and "no response" can be seen in Figure 5.

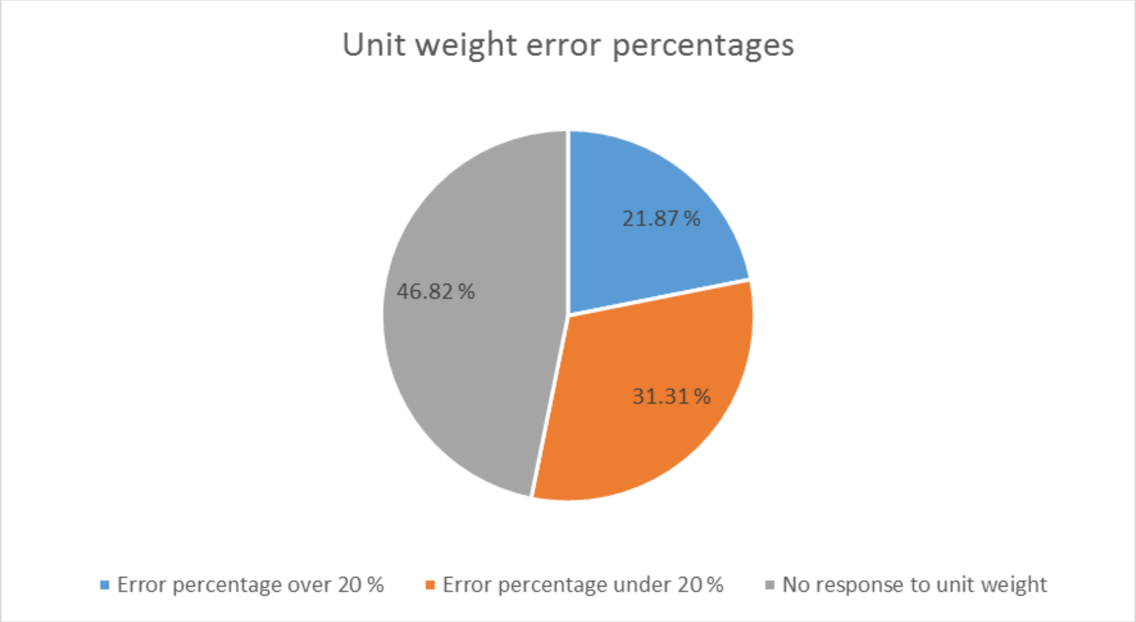


Figure 5 Unit weight error percentages

After it had been sorted which product IDs had an error percentage of 20 %, these were analysed for finding out the reason which might have caused this. The following tools were used when analysing these results:

- The unit weight given by the supplier, the ERP-system's unit weight and webshop's unit weight were compared to each other.
- The unit weight given by the supplier was compared to the possible picture of the product in the webshop.
- Based on the product's name it was estimated if the unit weight given by the supplier was realistic.
- The package weight given by the supplier was compared to the package weight test formula's result: if the weight given by the supplier was packing material's amount higher than the test formula's result, the weight given by the supplier was considered as valid. If the test formula's result was same as the weight given by the supplier, the unit weight was also considered to be correct. It is recognised that in these cases the weight of the packing material is divided into the weight of a single product, but it is assumed that the weight of the packing material is not so high that it effects on the unit weight significantly.

The analysis was done mostly by comparing the package weight given by the supplier and the test formula's result. It was assumed that for the unit weight to be correct, the package weight given by the supplier should be slightly higher than the test formula's package weight. Here it was presumed that the supplier had included the weight of packing material into the package weight. If the supplier given package weight was same as the test formula's result, it could be inferred that the unit weight was calculated by dividing the package weight with the package size. It was recognized that in this way the result was not the completely correct, but it was considered that the weight of the packing material divided into each unit's weight was not enough to influence the result correctness significantly.

Sometimes during the analysis the weight of the package weight given by the supplier was considerably higher or lower than the package weight test formula's result. In these cases the unit weight given by the supplier was compared to the webshop's information, pictures or it was estimated if the result was realistic in general. Based on this analysis the product IDs were divided into different categories. The different groups are presented as colour coded below:

- Green: Based on the analysis the data in the ERP-system is suspicious
- Red: The data given by the supplier is same as the webshop's data, the data in the ERP-system differs from these two
- Purple: The data in the ERP-system is not in the form of units
- Dark blue: The data given by the supplier is most probably incorrect

The percentages for each group can be seen from Figure 6. Based on the analysis, 39.21 % of the products with an error percent over 20 % seemed to have incorrect data in the company's ERP-system. With many products the data in the ERP-system seemed to be unrealistic, and it did not comport with the test formula's result. Since the validity of the existing data had not been monitored in any way, it could be concluded that the existing data was incorrect.

Even though the largest part of the error percentages over 20 % were caused by probable incorrect data in the ERP-system, the second largest cause for this were the suppliers who most likely were giving invalid information. In some cases this could be concluded from the test formulas results, and some of the given data was just unrealistic. All in all, 27.31 % of the products that had an error percent over 20 % could be considered as invalid information.

One factor that caused problems in the error percentage analysis was the fact that all the data in the ERP-system was not in the form of units. Some of the information was in packages, which automatically caused the error percent to be higher. Based on the analysis, 20.7 % of the higher error percent products were these products that had weight in different form in the ERP-system. In some cases the difference between units was easy to conclude, since the package size given by the supplier was equivalent with the ERP-system's weight information. However, with some products the package weight given by the supplier and the package weight in the ERP-system did not completely match. In these cases it could be assumed that either the data given by the supplier or the already existing information was invalid. Because the current analysis concerned only the unit weights, this was not analyzed any further.

With 12.78 % of the products the data in the ERP-system differed from the webshop's information. In these cases the webshop's data was same as the information given by the supplier, so here it could be assumed that the data in the ERP-system was incorrect. Since the validity of ERP-system's data had not been monitored previously, here it was assumed that the data given by the supplier could be considered as valid.

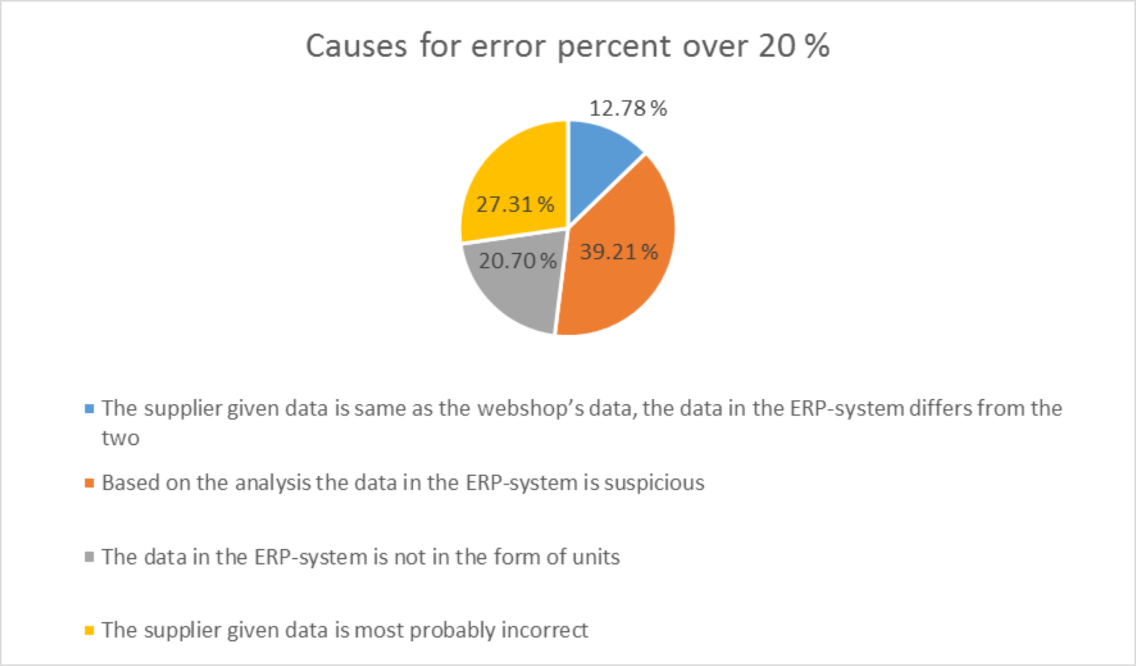


Figure 6 Causes for error percent over 20 %

5.1.3 Outcome of analysis

Based on the previous analysis it was suggested which product unit weights could be categorized as valid. It was suggested that all the product unit weight's that had an error percentage under 20 % would be accepted automatically. Also, the products that seemed to have incorrect unit weight information in the ERP-system and the products that had incoherent weight data between the ERP-system and the webshop would be accepted. It was also proposed that the products which had weight in the ERP-system in different form and the products where the supplier given information was clearly unrealistic, would not be accepted as valid. In other words, from the products where error percentage was over 20 % the green and red product groups would be accepted as valid and the purple and dark blue product groups would not be considered as incorrect. This proposal was given to the representative of the company.

When analysing the unit weight of these product IDs and their error percents, also following observations were made:

- In some cases the supplier had not given the data in requested form
- The concept of unit might differ among the suppliers
- In small figures even a little error might cause larger error percent, since the error percent is relative

Most of the problems with the data given by the supplier related to the data not being given in the correct form. When examining the unit weight, it could be noticed that often the supplier had given the package weight. To some extent this can be explained with the other observation that was made, which was that the concept of unit might have differed among the suppliers. The product sampling of this thesis included different kinds of products, where some of them cannot be sold in units. With these products it can be assumed that the concept of unit for the supplier is the smallest possible sales package. Since this sampling included such a large variety of products, defining the concept of unit may vary widely among the suppliers.

Another observation that was made during the analysis involved the relativity of the error percentages. It was noticed that especially with the smaller values even a little difference might have caused larger error percent. This can be assumed to be caused by the relativity of the error percentages; when the figure is small, the difference seems larger.

5.2 Main problems

During the research the main problems related to the questionnaire answers and the analysis of the results. Sometimes it was difficult to get the answers from the suppliers in the requested form, which complicated the result analysis. In Figure 7 are presented the main problems that occurred in the suppliers' answers.

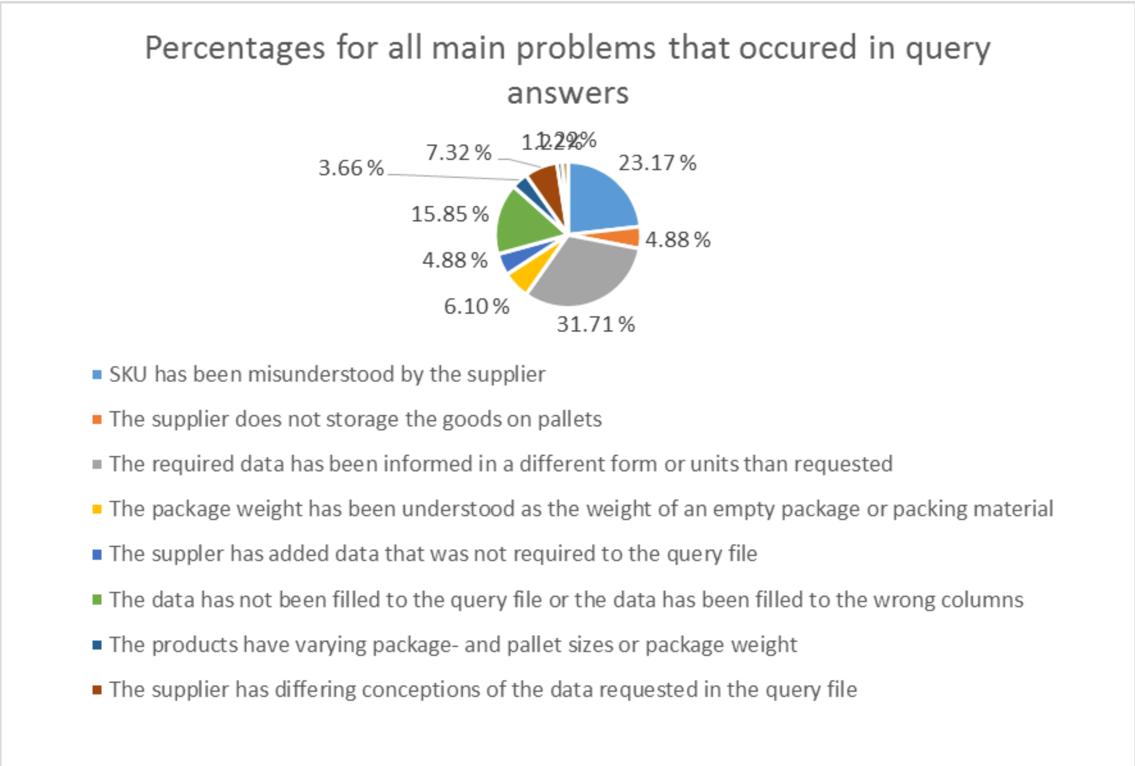


Figure 7 Percentages for all main problems that occures in query answers

As it can be seen from the figure, the biggest problem in the answers was that the required data had been informed in a different form than requested. Out of all the problems that occurred, 31.71 % was about the suppliers answering in the incorrect form or unit. Possible reasons for explaining this result can be the supplier not reading the cover letter, the required data information or the concept definitions-sheet properly. Another reason can relate to the data being copied staright from the supplier’s own ERP-system. From this result it can be concluded that the importance of answering in the correct form should have been emphasized more in the questionnaire or the cover letter. For the suppliers it might have been good to know beforehand that the data is supposed to be copied straight from the questionnaire, which might have decreased the amount of error concerning this factor.

The second most common problem was with the understanding of the stock keeping unit correctly. 23.17 % out of all the main problems related to misunderstanding the SKU. This can probably be explained with the fact that the concept of stock keeping unit is not consistently known among the suppliers all around the world. SKU can also be know as a product code, which may confuse the suppliers. Anyhow here again the reason for the high error percent can be explained with the fact that the supplier has not read the concept definitions-sheet properly, which would have explained the content of the required stock keeping unit.

The third largest problem with the questionnaire answers related to the required data not being filled to the questionnaire or the requested columns. 15.85 % of all problems concerned this issue, which complicated the analysis of the results significantly. Some of the suppliers needed to be contacted again in order for them to fill the answers to the questionnaire. The repetitive incidence of this problem shows again that the importance of answering the questionnaire as requested should have been accentuated more.

For the rest of the problems in the questionnaire answers the percentages were relatively equal. As it was also addressed in the unit weight analysis, 7.32 % of the problems related to the suppliers having differing conceptions of the requested data. Depending on the products, the supplier might comprehend for example unit or package differently than it was intended in the questionnaire. Other misunderstanding that appeared relatively often concerned the package weight. 6.10 % of the problems were about the package weight being understood as the weight of an empty package. In the light of the current results, it can be said that in the questionnaire this should have been expressed as a full package weight. Another problems that occurred in the questionnaire answers included additional data added to the questionnaire file, the supplier not storing the goods on pallets and the products have varying package or pallet sizes, which lead to varying package weights. When the supplier has these varying package and pallet sizes, it is hard to be prepared for the incoming goods. The problems that occurred only once included the supplier informing the incorrect data in the incorrect columns and the supplier changing the data that was required in the questionnaire file. If these kind of answers had appeared more frequently, that would have made the data collection and analysis very difficult.

If the occurred problems are viewed based on how many suppliers had mistakes in their answers and not by the total amount of problems, it can be said that 20.16 % of the suppliers had informed the data in a different form than requested. 14.73 % of the suppliers had understood the stock keeping unit incorrectly, and 10.08 % of the suppliers had filled the data into wrong columns or the data had not been filled to questionnaire at all. Rest of the problem percentages examined by the amount of suppliers who had answered incorrectly can be seen from Figure 8.

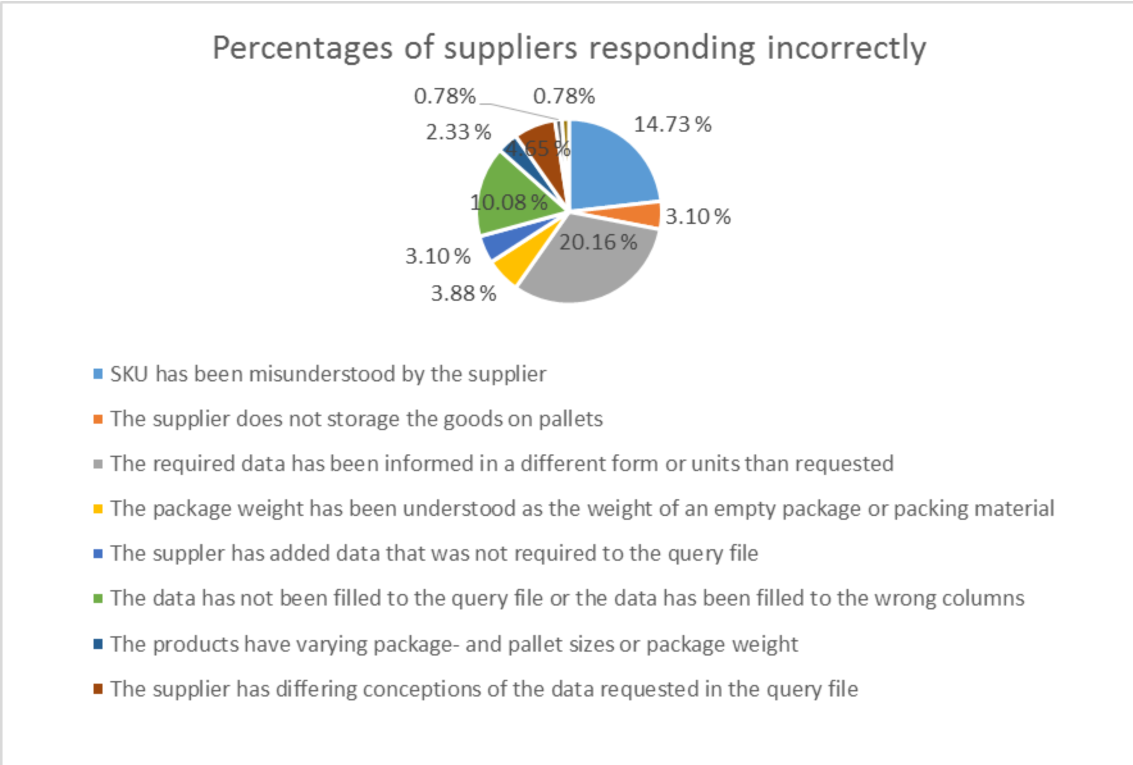


Figure 8 Percentages of suppliers responding incorrectly

All in all, quite many suppliers needed to be contacted again after receiving the first questionnaire answers. Since there were 129 suppliers, there were also multiple possible issues concerning the questionnaires and the comprehension of them. Few of the suppliers were interested to know for which use the information is collected, before they send their answers. Still there were a lot of issues which could have been evaded if the suppliers had read the cover letter and the questionnaire instructions properly before responding.

6 RECOMMENDATIONS

The results of this questionnaire give a lot of information and ideas on how this data could be collected and monitored in the future. The result analysis has now indicated which aspects worked well in the collection method and which factors could be improved. When organizing the collection of this data, there are two possible starting points. Either the data is requested from the supplier or the supplier gives the data automatically to the company. When collecting data for large mass of products, this usually has to be done by requesting the supplier to give the information for selected or new products. As it was said in the current state analysis, in Etra the collection of data for now has been done when the new products are opened into the ERP-system. Now Etra intends to collect this data for all the products that are stored in the warehouse. Since the data collection is done for already stored products, the old collecting method is not sufficient anymore. New procedures need to be developed for efficient data collecting, and this project pursued to create these methods for the company. Below are presented the proposed operation modes, which are designed to enhance the company's data collecting processes.

6.1 Instructions for future monitoring

As it was previously addressed, the company required guidelines and instructions for the future collection of weight and volume data. Here the suggestions for improvements are divided into two parts. One part is focused on improving the data collection processes, and the other part is about enhancing the data validity controlling. There are few suggested methods for the data collection, and proposals on how the data could be collected in the future.

6.1.1 Suggested data collecting methods

Based on the response percentages and result analysis it can be said that the original questionnaire worked relatively well, but it also had few visible problems. It was decided that the original questionnaire file could be recommended also for future use, but based on the result analysis it needed to be modified in more understandable form. When examining the result analysis, it can be seen that the concept of stock keeping unit had caused 23.17 % of all the problems in questionnaire answers. This percentage is relatively high, and none of the other requested data itself caused this many problems in the questionnaire answers. It was also considered how important this information is for Etra, and does it give any added value to the company. It was decided that the benefits obtained from this were not big enough to revoke the problems caused by this information. On the grounds of these considerations, it was decided to remove the stock keeping unit from the improved questionnaire file.

When the questionnaire file was examined for more improvements, it was noticed that the full pallet size created unnecessary repetition for the pallet layer measurements. The pallet layer measurements were informed in their own column, and they were mentioned again in the full pallet size column. The full pallet size-column decided to be changed to full pallet height, which erased the repetition of information.

Based on the result analysis, 6.10 % of the problems related to the supplier misunderstanding the package weight as the weight of an empty package or packing material. To reduce these misconceptions, the package weight was modified as a full package weight. It was assumed that this would decrease the amount of errors and make the concept of the required package weight more obvious to the suppliers. The package measurements were also added to the improved version of the questionnaire file. It was considered that with package measurements the package volume's validity monitoring would be more exact than with the previously used package volume's test formula. Otherwise the questionnaire file remained the same, since good results were also received with it. The improved questionnaire file is presented in the appendix 5.

Even though the original questionnaire achieved good results, another questionnaire form was developed for the data collection. This was the lighter version of the improved questionnaire and it included all the same basic information. The difference between the improved questionnaire and the lighter questionnaire form was that in the lighter questionnaire form the weight and volume data was collected only for the unit of measure that is in Etra's ERP-system. This would make it easier to run the data straight to the ERP-system. This would also facilitate the work of the supplier, since there would be less data to fill to the questionnaire. This lighter version of the questionnaire included supplier's basic information, which contained the supplier's name, supplier ID, Etra's product ID, the product name and Etra's unit of measure. For the data that would be collected it included net weight, volume, pieces per package, pieces per pallet, pallet layer and full pallet height. The supplier is supposed to give the net weight and volume in Etra's unit of measure. This eliminates all the excessive information from the questionnaire, and only the most essential data is collected. A shorter questionnaire might also make the suppliers respond better, when the appearance of the questionnaire does not seem so laborious. This version of the questionnaire can be seen in the appendix 6.

To ease the data collecting process, it was suggested that both of these questionnaires would be transferred into reports that could be uploaded from the company's reportage tool. At the moment there is a report that shows all product IDs that certain supplier has, and the possible net weight and volume that is assigned to the product in the ERP-system. This kind of report could be made from both of the earlier suggested questionnaires. Certain supplier's products could be searched by the supplier ID, and the report would include the same basic product information that was in the questionnaires. The possibly already existing weight and volume information would also be showing in the report. The report would be transferred to excel, and those products that already have the required data could be removed from the file. This file with the remaining products would be sent to the supplier just as it was previously suggested. When using the reports the data collecting process would basically be the same as it was originally, only the product IDs and basic information could be searched by the supplier ID and no copying to separate file would be acquired. This would decrease the amount of waste inside the collection process, which would make the data collecting faster and easier. When the collection process does not add any excessive strain to the employees, it could be assumed that also the collecting would be done in a faster pace.

As it was addressed in the current state analysis, currently Etra is collecting weight information when new products are opened in the ERP-system. Weight is collected in the product ID opening form, among the other data required for a new product. It is suggested that the unit volume is also added to the product ID opening form. With this procedure it would be ensured that at least unit volume would be collected from the suppliers, and this would be done immediately when the new product ID is opened. This would be a natural way of collecting data, and there is already an existing place for the unit volume in the company's ERP-system.

As it became clear from the result analysis, most of the problems concerned the data being given in other form or units than requested. All in all 20.16 % of the suppliers gave data in the incorrect form, which tells that the importance of responding in the requested form should have been emphasized more. Because of this it was decided that the cover letter needed to be modified in a more specific form, and this improved cover letter is presented in appendix 7. In the enhanced cover letter the importance of correct responding style is highlighted, and it is explained why this is crucial. It is also mentioned that it is important that the supplier gives all the information they got, and if they do not have valid data then they should leave the particular column empty. If the supplier does not have certain data or is uncertain of what particular question means, it is better to leave the column empty than to estimate something or answer in incorrect form. These estimates complicate the result analysis significantly, and it is not always guaranteed that the error can be detected among the other data. This again distorts the validity of the whole data set.

For the collection of data, it is suggested that purchasers and product managers collect weight and volume data from the products in their own product group. These are the people who have the best product knowledge, since they are dealing with the products on a daily basis. When there is some kind of knowledge about the items, it is easier to estimate if the given data is correct or not. Of course the data colleting adds additional strain to the workload, but all the required basic product information can be uploaded from the company's reporting tool and transferred to the questionnaire file in excel. After this the questionnaire file is sent to the supplier, whose commission is to fill the questionnaire. If the supplier is able to fill the file accordingly, it is possible to run the data straight to the ERP-system. Before the data is inserted into the ERP-system, the validity of it can be verified. The validity of the data can be inspected with the test formulas, which is relatively easy and quick way to monitor the data. The test formulas however function best when they are used with the improved version of the original questionnaire, since there unit weight, package weight, unit volume and package volume are separated.

The data could also be collected at the same time when new product ID's are opened into the ERP-system. The most required information could be added to the product ID opening template, when the supplier would give the additional data at the same time when they give the other necessary product information. This way the weight and volume information would not have to be collected separately, which would decrease the amount of work in the company and in the supplier's organization. This would also reduce strain from the product management department, which inserts all the data into the ERP-system. All the required data could be collected in the same template, which in the future would help the data collection and database maintenance.

All in all, here are summarized all the development proposals for data collection:

- Purchasers and product managers start collecting weight and volume data for the products in their product group
- Questionnaires are transferred to reports, which optimizes the data collection process
- Improved questionnaire is sent to the suppliers in order to collect data for already stored items
- If the improved questionnaire seems too extensive, the lighter version of the questionnaire can be used. Here only the most relevant data is collected.
- At least the unit volume is added to the product ID opening template, also other essential information could be added there. In this way all the necessary data is collected before the products arrive to the warehouse.
- Improved cover letter is used when sending the questionnaires to the suppliers

The development proposals are designed in a way that they generate additional strain as little as possible to the people who collect the data. The objective was to create data collecting methods that are easy to use and do not increase the amount of work significantly. Still it was noticed that requesting the data from the supplier was the most efficient data collecting method for products that are already in the inventory. This way it is possible to collect large masses of data, and the data is in standardized form which makes the data processing easier.

6.1.2 Suggested data monitoring methods

As it was previously stated, the most efficient data collecting method was noticed to be the questionnaire form. When the data is collected with the questionnaire, it is also easier to go through in case of errors. One efficient validity monitoring method are the test formulas, which were also used in the result analysis of this thesis. Here the test formulas were created for unit weight, package weight, unit volume and package volume. When analysing the unit weight, it was compared to the unit weight that already existed in the company's ERP-system. This was not discovered to be the most reliable baseline, since the validity of the existing data was not previously monitored. In this way it could not be said that the data in the ERP-system was valid. Unit volume's test formula was also created with the same principle; the supplier given unit volume was also compared with the existing unit volume. Same problems emerged here than with the unit weight test formula, so this either cannot be considered as reliable. During the result analysis it was noticed that best way to survey the unit weight and volume's validity was to compare the supplier given package weight and volume to the test formulas results. If the supplier given package weight or volume was slightly higher than the test formula's result, it can be assumed that also the unit weight and volume were correct. This is based on the fact that package weight should include the weight of packing material and package volume should include the empty space inside the package. The test formula did not include the packing material weight or the empty space inside the package. When this is taken into consideration, it would be realistic that the test formula's result would be less than the actual weight or volume. During the result analysis also those products that had same value as supplier given data and the test formula's result were considered as valid. It can be assumed that in these cases the error is not so significant that it would affect the result substantially.

When analysing the unit weight, all the products that had an error percentage under 20 % were considered as valid. Small errors between the data given by the supplier and the test formula's result were common, and it was assumed that they will not influence the validity of the data significantly. Test formula's result could be said to be more like a guideline on what the supplier given information should be about. This same percentage is also suggested to be used when the data is monitored in the future. When 20 % is used as a limit, it can be said that small errors are not taken into consideration but larger errors can be noticed better. The result analysis is also easier when there is a set limit which could be used in the dividing the products as valid and incorrect.

In other words, package weight and volume weight test formulas are suggested to be used in the monitoring of the data validity. With these test formulas it is possible to examine both unit and package data. When surveying the unit data, the supplier given information can be considered as valid if the supplier given package data is larger or same than test formula's result. This can be checked from the error percent. Package data can be considered as valid if the error percent between package data given by the supplier and the test formula's result is under 20 %. This kind of operating model is also suggested to the company, since it is relatively simple to use and both unit and package data's validity can be examined from the same test formula.

Another suggestion for the monitoring of data are sample tests for the products that are already stored in the warehouse. Sample tests are a good way for surveying if the data given by the supplier is correct, and if not then how much is the error between the supplier given data and the self-measured result. A revision form was made for the sample tests, which can be used for checking the already stored items. This revision form is presented in appendix 8. The basic information that this form includes are Etra's product ID, the product name and Etra's unit of measure. The person who is doing the test sampling is supposed to measure the weight and volume of the Etra's unit of measure. The weight is supposed to be informed in kilos and the volume in cubic metres. The product ID and product name can be searched from the ERP-system. When both name and product ID are included in the form, the person executing the sample tests can check if they are handling the right product. Etra's unit of measure is also searched from the ERP-system. It was decided that Etra's unit of measure would be the most sensible factor to monitor, since it effects on the company's operations more than the other possible units. It can also be assumed that most of the products in the warehouse are stored as this same unit of measure.

Weight and volume information were the most important measurements for the company, so it was decided that only these would be measured in the sample tests. It was suggested that these would be measured from Etra's stock keeping units. This means that if the SKU was a package, then the weight and volume of one package would be measured. When examining only Etra's stock keeping units, the amount of excessive work is decreased since unnecessary data is not included in the revision. The validity auditing is faster when only the most important aspects are measured. Products for the sample tests could be chosen randomly, and the tests could be executed when there is spare time in the warehouse. The revision form can also be used to collect information from products whose supplier has not responded to the questionnaire or given some specific information. Products which do not have any weight or volume information can be searched from the ERP-system and gone through as spare time emerges. This way the quieter times in the warehouse can be used efficiently, and more data is being examined and collected.

Sampling tests for the incoming goods can be executed with the same revision form that was used for the products already situated in the warehouse. Still another validity monitoring method was created for the sampling tests of the incoming goods. Here again the same factors are measured than in the previous revision form, the measurement result area is just situated in the goods receiving list. Here the person who is receiving the goods can measure them before they are taken to the shelf. The goods receiving lists that have measurements on them can be gathered aside and the information from them can be inserted into the ERP-system. In goods receiving this method can be used for sample testing the products that already have this information in the ERP-system, or it can be used for collecting the weight and volume data. It is possible to print out a list of products that are coming to the warehouse for the first time, and based on this list these questions and measurement result areas can be situated into the goods receiving lists. This way the necessary data can be collected when the products arrive to the warehouse for the first time, even if the data is not received with the product ID opening template. This again makes the data collection more efficient and solid.

Weight data in the company's ERP-system is marked either in kilos or grams. From the point of database maintenance and data validity control, it is important that all the data in the ERP-system is in coherent form. In this case all the data should in inserted to the ERP-system in kilos or cubic metres, since these are the default units. The importance of the contiguous notation of data should be accentuated throughout the company, in order of decreasing errors caused by invalid data. When inserting the weight and volume data into the ERP-system, at least the correctness of unit of measure should be verified. This way it can be ensured that the notation of data is coherent. In other words it should be checked if the weight is in kilos and the volume is in cubic metres. Since the weight and volume were the most important information to the company, it would be good if at least these measurements were inspected. It is understandable that the employees do not always have the time to do this, and along with the normal work load the inspection might seem impossible. In these cases the employee who is doing the data examining, can just send the supplier an email asking can you ensure that this data is given in requested form. This way the responsibility is transferred to the supplier, and it is their job to make sure that the data is given in correct unit of measures.

7 UTILIZATION OBJECTS FOR COLLECTED DATA

In general the collected weight and volume data can be used to improve multiple inventory operations. Useful objectives would be for example the inventory capacity planning, delivery planning and the goods reception planning. With product weight and volume data it is possible to improve the general operability of the inventory, and with the correct planning the warehouse's full capacity can be put to use. In this chapter it is discoursed how the weight and volume data could be used to improve Etra's inventory operations.

As it was previously addressed, the weight and volume data could be used to improve Etra's warehouse capacity. Planning of the inventory layout decreases the amount of waste space, which helps the company to utilize the full capacity of the warehouse. Especially product volume information is useful here. When the volume is known, the products can be located to the warehouse even before they arrive there. Products that arrive in full pallets are easy to locate when the pallet volume or measurements are known. When pallets are stored to places where the space utilization is maximized, the amount of waste space is decreased. When the product volume, demand and the inventory levels are known, it is easier to determine where the products should be located in the warehouse.

Products that do not come in full pallets can also be located to the warehouse in advance. When the product volume is known, the right pallet size can be selected before the products arrive. This can be done by selecting the right pallet size in beforehand, and locating the goods into the warehouse based on this pallet size. When the whole pallet area is utilized, the amount of waste space is decreased. The goods can also be located into the warehousing automat, where the product volume is an essential information when mapping the locations for the products. When inventory levels and product volume are known, it can be defined how large location the product requires in the warehousing automate. As the required location size is determined beforehand, the put away to the warehousing automat is faster (Kuchta 1996, 37).

Volume information can also be used if Etra wants to proceed to the fixed location warehousing system, where products are assigned to permanent locations (Viale 1996, 81). With the volume information and targeted inventory levels it is possible to assign suitable storage cells for each product. The product weight can also be helpful when determining storage locations. Usually the heavy products are not situated in high picking slots, due to the picker's ergonomics. When the product volume is known, the human engineering of the employees can be taken into consideration when designing the inventory layout.

When considering the purchasing operations and incoming deliveries a little more, it can be noticed that weight and volume data can also be used there. The collected data may be helpful when deciding what kind of transportation means are used for the purchased goods. When the product weight and volume is known, it can be compared which transportation form or company would be the most economical. The collected data can also be used when defining freight charges for goods that are delivered from Etra's warehouse. When the total weight is known beforehand, appropriate freight fee can be charged from the customer.

Another aspect where product weight and volume information can be used is the goods receiving. Goods receiving can especially benefit from the product volume, from which the volume of the whole delivery can be estimated. When the estimated volume of the incoming delivery is known, it is easier to prepare and make room for it. If the estimated weight of the delivery is known beforehand, it can help with assigning the work for the employees. Certain people cannot lift heavy objects, so when the weight is known the deliveries can be assigned to people who have no problem with that. The total weight and volume of the delivery could be marked into the goods receiving list, where it is easy to see and the work can be divided fairly.

One last possible utilization object addressed here is the Etra's webshop. Product weight data is already visible there, but the volume data could also be added to the webshop. Sometimes it is difficult to understand the real dimensions from a picture, so the product volume or package measurements could be useful there. If the product volume and weight can be seen from the website, it can also help the customer to prepare for the incoming delivery and the possible freight charges.

In addition to these, there are other possible utilization objects for this collected data. Here are presented few of them, which might help Etra to enhance their business operations. Inventory capacity improvement surely is one of the most important aspects where the collected data is needed, and when examining the other processes inside the company the weight and volume data can be used almost in every operation that relates to the company's products.

8 CONCLUSIONS

This thesis project was executed between December 2015 and May 2016, and the results gained from the research were relatively good. The objective for the research project was to collect product weight and volume data, which the company could use to improve their business operations. Another aim of this project was to find methods that could be used in data collection and monitoring in the future. The data collection was conducted through a questionnaire, and test formulas were used for monitoring data validity.

The response percentage in this research was good, and a majority of the suppliers answered the questionnaire. The quality of the supplier answers varied quite a lot, and some error creating aspects could be noticed repeating in the supplier responses. Based on an analysis of the results, these confusion causing factors were modified into a more understandable form. Two different questionnaires were created for future use, and these were done based on the supplier responses. The company was also suggested to convert these questionnaires into reports, which would ease the collection process. Another proposition was to include volume data to the template that was used for requesting information for new products from the suppliers.

Based on the analysis, test formulas were recommended also for future use. In addition to these, product sampling tests were included into the suggestions. Monitoring product validity is important from the database management point of view, since incorrect data can disturb various business processes.

Since the error percent was relatively good, it can be said that the questionnaire worked well in collecting data. It was noticed that for a large mass of products a questionnaire is the easiest way for collecting information, because in that way the collection process is well organized and controlled. When the questionnaire is structured, it is easier to insert the data into the company's ERP-system. For a large group of products the validity monitoring can be difficult, but at least the correct unit of measure should be verified in case the supplier has given the requested information in an incorrect form. As a conclusion to this project it can be said that the commissioning company is recommended to continue the data collection with structured and standardized questionnaires, just because controlling data is easier that way. Weight and volume data can be used to improve several business processes, and the company should take advantage of them in enhancing their operations.

SOURCES

Baan, P. 2013. Enterprise information Management: When information Becomes Inspiration. New York: Springer

Bhatnagar, A. 2009. Textbook of Supply Chain Management. Lucknow: Word-Press. Referenced 13.4.2016. Available in Ebrary: http://site.ebrary.com.ezproxy.hamk.fi/lib/hamk/detail.action?docID=10416831

Bowersox, D., Closs, D. & Helferich, O. 1986 Logistical Management. Third Edition. New York: Macmillan Publishing Company

Connolly, T. & Begg, C. 2005. Database systems: A Practical Approach to Design, Implementation, and Management. Essex: Pearson Education Limited.

Coronel, C. & Morris, S. 2015. Database Systems: Design, Implementation, and Management. Stamford: Cengage Learning

Crnkovic, I., Asklund, U. & Persson, A. 2002. Implementing and Integrating Product Data Management and Software Configuration Management. Norwood: Artec House. Referenced 4.5.2016. Available on Ebrary : http://site.ebrary.com.ezproxy.hamk.fi/lib/hamk/reader.action?docID=10082044

Etola-yhtiöt. 2016. Etola Group. Referenced 14.4.2016. http://www.etola.fi/en/home-en/etola-group/

Etra Oy. 2016a. Yritys. Referenced 14.4.2016. http://www.etra.fi/fi/Yritys/yritysinfo/

Etra Oy. 2016b. Historia. Referenced 14.4.2016. http://www.etra.fi/fi/Yritys/yritysinfo/historia/

Etra Oy. 2016c. Toiminta-ajatus. Referenced 19.4.2016. http://www.etra.fi/fi/Yritys/yritysinfo/toiminta-ajatus/

Hirsjärvi, S. Remes, P. & Sajavaara, P. 2007. Tutki ja Kirjoita. Helsinki: Tammi

Kuchta, J., CMC, CPIM and Gross & Associates. 1996. How to Save Warehouse Space: 149 Tested Techniques. New York: Distribution Center Management

Monk, E. & Wagner, B. 2009. Concepts in Enterprise Resource Planning. Third Edition. Massachusetts: Course Technology Cengage Learning

Muller, Max. 2011. Essentials of Inventory Management. Second edition. New York: AMACON Books. Referenced 13.4.2016. Available in Ebrary:

http://site.ebrary.com.ezproxy.hamk.fi/lib/hamk/detail.action?docID=10461073

Projektiuutiset. 2011. Etran Logistiikkakeskus. Referenced 19.4.2016 http://www.projektiuutiset.fi/etran-logistiikkakeskus/

Purchase Assist Technology. FAQ. Referenced 13.4.2016. Available in: http://purchase-assist.com/faq/

Van der Hoeven, Hans. 2009. ERP and Business Processes: Illustrated with Microsoft Dynamics NAV 2009. Coral Springs: Llumina Press

Viale, David. 1996. Basics of Inventory Management from Warehouse to Distribution Center. Boston: Course Technology/Cengage Learning. Referenced 13.4.2016. Available in Ebrary: http://site.ebrary.com.ezproxy.hamk.fi/lib/hamk/reader.action?docID=10060430

Wolter, R. & Haselden, K. 2006. The What, Why, and How of Master Data Management. Microsoft Corporation. Referenced 2.5.2016 https://msdn.microsoft.com/en-us/library/bb190163.aspx

Appendix 1

QUESTIONNAIRE FORM

Please fill the excel sheet's blanks as in example below:

Supplier code	Supplier	Etra product ID	Product name	Supplier product ID	Stock keeping unit (Warehousing unit)	Pcs per package	Pcs per pallet	Pallet layer (width cm x length cm)	Full pallet size (width cm x length cm x height cm)	Unit weight/kg	Package weight/kg	Unit volume/m^3	Package volume/m^3	Pallet volume/m^3
12345	Example	123456789	Example product	ABCD	pac	10	320	80cm x 120cm	80cm x 120cm x 120cm	0,4	4	0,0043	0,043	1,92

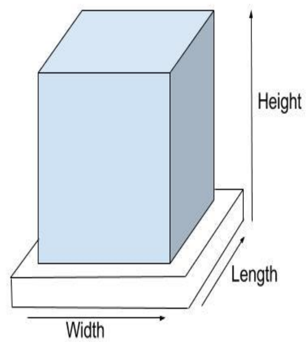
Supplier code	Supplier	Etra product ID	Product name	Supplier product ID	Stock keeping unit (Warehousing unit)	Pcs per package	Pcs per pallet	Pallet layer (base cm x height cm)	Full pallet size (width cm x length cm x height cm)	Unit weight/kg	Package weight/kg	Unit volume/m^3	Package volume/m^3	Pallet volume/m^3

Appendix 2

CONCEPT DEFINITIONS-SHEET

Concept definitions

Stock keeping unit (Warehousing unit):	The unit in which the products are kept in stock, for example single unit, package or pallet
Pcs per package:	How many pieces of each product one package contains
Pcs per pallet:	How many pieces of each product one pallet contains
Pallet layer (width cm x length cm):	Pallet layer dimensions, width x length of a pallet layer. Please use **cm** as unit of measure.
Full pallet size (width cm x length cm x height cm):	Full pallet dimensions, full pallet's width x length x height. Pallet's height is calculated from the floor to the top. Please use **cm** as unit of measure.
Unit weight/kg:	Weight of a single product, please use **kg** as unit of weight
Package weight/kg:	Weight of one package, please use **kg** as unit of weight
Unit volume/m³:	Volume of a single product, please use **m³** as unit of volume
Package volume/m³:	Volume of one package, please use **m³** as unit of volume
Pallet volume/m³:	Volume of one pallet, please use **m³** as unit of volume



Appendix 3

QUESTIONNAIRE COVER LETTER

Dear Etra’s Supplier,

Etra Oy is currently collecting missing weight and volume data for the products we supply from our warehouse. This data will be used to improve our warehousing operations and as Etra’s supplier, you are requested to fill this missing data for us in the Excel file attached.

In the Excel file you can find your product names and product ID’s for which we ask you to fill this data. From the file you can also find **Concept definitions**-sheet, which explains in detail what information we are looking for.

Actions required:

- Complete the missing data in the Excel file attached to this message
- Please return the completed Excel file to iina.eiste@etra.fi

You are requested to respond as soon as possible, but **29.2.2016 at latest.**
If you have any question concerning this request, please contact iina.eiste@etra.fi

Thank you in advance for your co-operation,

Appendix 4

QUESTIONNAIRE REMINDER LETTER

Dear Etra’s Supplier,

Earlier you received an inquiry concerning weight and volume data of some specific products. In that inquiry you were asked to respond latest at 29.2.2016.

Could you please fulfill the inquiry attached and return it to iina.eiste@etra.fi as soon as possible?

More detailed instructions you can find on the message below.

Thank you,

Appendix 5

IMPROVED QUESTIONNAIRE FORM

Please fill the excel sheet's blanks as in example below:

Supplier ID	Supplier	Etra product ID	Product name	Supplier product ID	Pcs per package	Pcs per pallet	Pallet layer (width cm x length cm)	Full pallet height	Unit weight/kg	Full package weight/kg	Package measurements (width cm x length cm x height cm)	Unit volume/m³	Package volume/m³	Pallet volume/m³
12345	Example	123456789	Example product	ABCD	10	320	80cm x 120cm	120cm	0,4	4	11cm x 19cm x 34cm	0,00071	0,0071	1,92
Supplier ID	Supplier	Etra product ID	Product name	Supplier product ID	Pcs per package	Pcs per pallet	Pallet layer	Full pallet height	Unit weight/kg	Full package weight/kg	Package measurements	Unit volume/m³	Package volume/m³	Pallet volume/m³

Appendix 6

THE CUT VERSION OF THE IMPROVED QUESTIONNAIRE

Please fill the excel sheet's blanks as in example below:

Supplier ID	Supplier	Etra product ID	Product name	Supplier product ID	Etra's unit of measure	Net weight/kg	Volume/m³	Pcs per package	Pcs per pallet	Pallet layer (width cm x length cm)	Full pallet height
12345	Example	123456789	Example product	ABCD	pac	4	0,02	10	320	80cm x 120cm	120cm

Supplier ID	Supplier	Etra product ID	Product name	Supplier product ID	Etra's unit of measure	Net weight/kg	Volume/m³	Pcs per package	Pcs per pallet	Pallet layer	Full pallet height

Appendix 7

IMPROVED COVER LETTER

Dear Etra's Supplier,

Etra Oy is currently collecting missing weight and volume data for the products we supply from our warehouse. This data will be used to improve our warehousing operations and as Etra's supplier, you are requested to fill this missing data for us in the Excel file attached.

In the Excel file you can find your product names and product ID's for which we ask you to fill this data. From the file you can also find **Concept definitions**-sheet, which explains in detail what information we are looking for. It is very important that only the requested data is filled to the questionnaire. We also hope that all the requested data is filled to the appropriate columns, since this facilitates our work considerably.

Actions required:

- Please read the questionnaire instructions properly
- Complete the missing data in the Excel file attached to this message
- Please return the completed Excel file to iina.eiste@etra.fi

You are requested to respond as soon as possible, but **29.2.2016 at latest.**
If you have any question concerning this request, please contact iina.eiste@etra.fi

Thank you in advance for your co-operation,

Appendix 8

REVISION FORM FOR SAMPLE TESTS IN THE WAREHOUSE

Nimike	**Tuotteen nimi**	**Mittayksikkö**	**Mittayksikön paino kg**	**Mittayksikön tilavuus m^3**